REMARKS

Favorable reconsideration is respectfully requested.

The claims are 1-24, with claims 1-14 and 19-23 being withdrawn from consideration.

The rejected claims are 15-18 and 24.

Claims 15-18 are rejected under 35 U.S.C. 102(e) as being anticipated by Gaku et al. (U.S. 6,280,641).

This rejection is respectfully traversed.

The rejection states that as to claims 15 and 16, Gaku et al. discloses a process for making a hole in a metallic-treated copper foil surface of a copper-clad board or printed circuit board by irradiating a carbon dioxide gas laser beam having an energy of 20-60 mJ by means of the pulse oscillation of the laser beam (column 4, lines 11-29) and that as to claim 15, Gaku et al. teaches that an alloy of the copper foil and the metallic-treatment layer is inherently formed during the formation of copper-clad laminate (column 6, lines 27-36, claim 15).

In reply, the present invention is a method of making a hole in a copper-clad board, in which a metallic-treatment layer which is formed on a shiny surface of a copper foil and contains nickel as an essential element is disposed on a thermosetting resin composition layer such that the metallic-treatment layer becomes a surface layer, an alloy of the metallic-treatment layer with copper is formed by heating, and the metallic-treatment layer is directly irradiated with carbon dioxide gas laser energy by means of the pulse oscillation of the carbon dioxide gas laser, to make a penetration hole and/or a blind via hole.

Independent claim 15 is directed to a method wherein the energy of the irradiation is essentially the same from beginning to end. Independent claim 24 is directed to a method wherein the energy of the irradiation increases from beginning to end.

Gaku et al. (U.S. 6,280,641) discloses a method of making a micro-via hole, in which a coating or sheet of an organic substance formed of a coating composition containing at least one member selected from the group consisting of a metal compound powder, a carbon powder and a

metal powder is provided on a surface of a copper foil as an outermost layer and the micro-via hole is made by irradiation with a carbon dioxide laser, as is recited in claim 1.

In column 6, lines 27-36, Gaku et al. discloses that the surface copper foils of the double-sided copper-clad laminate as an inner layer are oxidized to form a copper oxide layer, a prepreg, a resin sheet, a resin-attached copper foil or the like is placed on each surface and the resultant set is laminate-formed under heat and pressure.

Further, in column 8, lines 46-56, Gaku et al. discloses that when a via hole is made in the double-sided copper-clad laminate, the copper foil surface which is to be irradiated with a carbon dioxide gas laser is oxidized to form a metal oxide, or a coating or sheet formed of a resin composition containing a metal compound powder etc., is provided on the above surface.

It is obvious that Gaku et al. does not disclose that the alloy layer of nickel, which is an essential element of the present invention and copper is formed on the copper foil surface. That is, Gaku et al. only discloses that the oxide layer of copper is formed, but does not in any way disclose that the alloy layer of nickel and copper is formed on the copper foil surface.

Accordingly, it is apparent that the rejection on Gaku et al. under 35 U.S.C. 102(e) is untenable.

The rejection states in Official Action paragraph 2 that Gaku et al. teaches that the surface of the copper foil to be irradiated with the laser is oxidized to form a metal oxide or coating or a sheet is formed and the coating comprises a metal powder such as nickel and would inherently provide the property of high absorption of carbon dioxide gas laser by nickel as evidenced by Rogers (U.S. 5,257,140).

The invention of Rogers relates to a mirror for infrared and visible wavelength radiation. Rogers discloses that "In the Perkin-Elmer design, the nickel layer absorbs over quite a large band, including the carbon dioxide infrared laser frequency."

However, Rogers does not teach that the alloy layer of copper and nickel is formed on the copper foil surface and the alloy layer is irradiated with a carbon dioxide gas laser to make a hole.

Gaku et al. does not teach that a hole is made in the copper foil having the above alloy layer. That is, Gaku et al. discloses that a coating containing a metal powder such as nickel is

formed and the coating is irradiated with the laser to make a hole, while Gaku et al. does not teach that an alloy layer is formed from the above metal powder and nickel. The method of Gaku et al. does not comprise heating and pressurizing after the formation of the coating.

In the present invention, the formation of the alloy layer constitutes an important requirement having the following meaning. The alloy layer is formed when the double-side-treated copper foil having a metallic-treatment layer and a thermosetting resin layer are laminate-formed under heat and pressure. In the invention of Gaku et al, the copper foil surface is oxidized to form a layer of copper oxide in advance, and is unsuggestive of the alloy layer of nickel and copper used in the present invention.

Further, the formation of the coating or sheet containing a metal powder, etc., on the copper foil surface is not the formation of the alloy layer with copper. The alloy layer of the present invention and the metal oxide layer, i.e. copper oxide, of Gaku et al. are different in constitution.

In the present invention, the alloy layer of copper and nickel is formed on the copper foil surface during the laminate-formation, and thus a special step for the formation of the alloy is not necessary. In addition, the alloy layer is not peeled off by surface friction so that is advantageous in view of workability. Moreover, it is high in laser absorption efficiency, making it easier to produce a hole with a carbon dioxide gas laser.

Therefore, it is not possible to arrive at the present invention from the teachings of Gaku et al. and Rogers in the absence of improper hindsight reconstruction of the present invention.

Further, it is apparent that although nickel is excellent in the absorption of the carbon dioxide gas laser, no one of ordinary skill in the art could easily know whether the alloy layer of nickel and copper is useful for making a hole with a carbon dioxide gas laser when the alloy layer is formed on the copper foil surface.

Accordingly, the rejection of claims 15-18 as anticipated by Gaku et al. or any rejection on Gaku et al. and Rogers is untenable.

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Inagawa et al. (U.S. 5,073,687) in view of Takami (JP 4-71292).

The rejection states that Inagawa et al. discloses a process for making a hole in a copper-clad board by irradiating a laser beam by means of the pulse oscillation of a carbon dioxide gas laser and the irradiation energy of the laser increases from beginning to end. The rejection also states that in a method of making a copper foil for printed circuit board, Takami teaches that the copper foil is treated to form a coating of a barrier layer consisting of nickel to improve the heat resistance and adhesion capabilities of the copper foil.

The rejection concludes that it would have been obvious to one skilled in the art to combine Takami's teaching into Inagawa's process for improving the heat resistance and adhesion capabilities of the copper foil during the manufacturing of a printed circuit board.

This rejection is respectfully traversed.

Takami (JP 4-71292) discloses a copper foil for a printed circuit which copper foil has a barrier layer, which consists of copper, zinc and nickel, on at least one surface thereof (claim 1). The above barrier layer consists of 50 to 85 wt% of copper, 15 to 50 wt% of zinc and 0.2 to 5 wt% of nickel (claim 2).

Takami relates to a copper foil having high heat resistance for a printed circuit, which copper foil has less deterioration of adhesive strength due to heat when it is bonded to a base material resin for printed circuit.

In Takami, the barrier layer having the specific constitution as shown in claim 2 has the above effect. Takami does not disclose or suggest whether a function such as the function of the present invention is performed when a hole is directly made in the copper foil having the barrier layer with a carbon dioxide gas laser.

Inagawa (U.S. 5,073,667) discloses a method of forming a hole in a working object such as a print board with a carbon dioxide gas laser (claim 1). Inagawa discloses only that "the pulse output signal is made variable in accordance with each portion of the copper foil portion and the resin portion of the front surface of the print board and the copper foil portion of the back surface". However, Inagawa does not disclose or suggest that the metallic-treatment layer is formed on the copper foil and the copper foil having the metallic-treatment layer and the thermosetting resin composition layer are laminate-formed under heat and pressure to form an alloy layer of copper and nickel by the heating.

Further, there is no description or suggestion that the above formation of the alloy layer produces a copper-clad board suitable for making a hole with a carbon dioxide gas laser.

Takami describes only that the copper foil having the barrier layer having the specific constitution gives a copper foil having high heat resistance for a printed circuit. Takami does not disclose or suggest that an alloy layer with copper is obtained from the barrier layer and that the alloy layer can give a copper-clad board suitable for making a hole with a carbon dioxide gas laser.

Thus, it is not possible to arrive at the present invention from the teachings of Inagawa and Takami.

Furthermore, Inagawa discloses in column 7, lines 51 to 54 of the present specification that "According to the experiments, when a laser beam of 10 mJ (millijoule) per pulse was irradiated at an oscillation period of 100 Hz". In this case, there is no description of what kinds of copper foils were used in the experiments.

However, Example 1 of the present specification discloses that the holes were made in the double-sided copper-clad laminate, obtained by using the nickel-treated electrolytic copper foil, with a carbon dioxide gas laser at an output of 13 mJ. Comparative Example 1 of the present specification discloses that, when general copper foil without the nickel metallic-treatment was used to prepare a copper-clad board, no holes could be made in the copper-clad board since the laser beam was reflected. Comparative Example 2 of the present specification discloses that when a copper foil which had been treated to form black copper oxide was used, almost no holes were made by irradiation of a laser beam.

Holes can be made in the present invention's copper-clad board whose surface is metallic-treated, at an output energy of approximately 10 mJ, and none of the cited references alone or combined teach that such a hole formation is possible.

For the foregoing reasons, it is apparent that the rejections on prior art are untenable and should be withdrawn.

No further issues remaining, allowance of this application is respectfully requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact undersigned at the telephone number below.

Respectfully submitted,

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